# Brief Introduction to the National Open Innovation System (NOIS) Paradigm: Supporting individual creativity in an online social network with content recommendation


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**Abstract:**. On the basis of beliefs on open innovation, online social networks and Web 2.0, we propose a new type of approach based on people-to-people interaction to support national innovation activities. With the aim of generating new ideas, our National Open Innovation System (NOIS) combines two rival innovation sources: (1) technology and social foresight research, and (2) customer needs and experiences (i.e. customer orientation strategy). By integrating content recommendation tools with NOIS, we increase the dynamics of the individual's creativity and create an online environment where conventional habits are easily exceeded. Combined, the approaches of collaborative content production and intelligent content recommendation will significantly boost the possibilities of unexpected findings, which have been identified as a major innovation source.



**Keywords:** Open innovation, National Innovation System, Foresight, Customer orientation, Recommendation


## 1 Introduction

Recently there has been increased attention on the concept of "open innovation", which refers to combining internal and external ideas and internal and external paths to market, in order to advance the development of new technologies (Chesbrough, 2003). In general, innovations are important building blocks of today's economies. Organisational and individual knowledge and creativity are used for creating novel processes, products and services (Huiban and Boushina, 1998; Kenney, 2001; Taatila et al. 2006). Innovations have a major impact on national economies, and are a big factor in creating competitive advantages for nations (Tuomi, 2002). Thus the most competitive countries in the world typically have extensive and sophisticated national innovation systems (later NISs), whose theoretical foundations were built in the late 1980s (Freeman, 1987; Lundvall, 2007).

Since the 1990s, the commercialisation and rapid growth of the Internet and World Wide Web (later the web) has created the most promising platform for connecting people and communication. As a result of this technological transformation, we predict that innovation environments in general will change radically in coming years. In the last decade, a growing number of studies and experts have also argued that the recent progress in information technology and information infrastructure is enabling companies to customise products and services in high volumes at a relatively low cost (Gilmore and Pine 1997). The management system based on mass production of customised products is called mass customisation (Pine 1993). In principal the main aim of mass customisation is to provide superior value for customers by producing customised, affordable, high-quality goods and services with shorter cycle times and lower costs (Hart 1995; Anderson 1998).

Interestingly, one of the main change drivers of the moment seems to be online social networks (later OSNs) based on Web 2.0, which are generally communities and hosted services facilitating collaboration and sharing between users (Cachia, Compañó and Da Costa, 2007). In principle, OSNs facilitate interaction among members by providing a dynamic/multimodal platform which enables versatile services such as discussions, sharing of multimedia content, organisation of social events and information-sharing, among others. We believe that OSNs can be utilised as a critical part of NISs. Therefore in this article we present a National Open Innovation Systems (NOIS) paradigm with an integrated content recommendation approach aimed at increasing the likelihood of unexpected findings, which should trigger novel ideas.

The paper is structured as follows: in the next section, we briefly present the body of knowledge that exists on innovations. We then present and discuss our NOIS concept and integrate the content recommendation approach to NOIS. Finally, we draw conclusions.

## 2. Unexpected Findings as a Source of Innovation

### *2.1 Theoretical foundations*

According to Taatila et al. (2006), economic innovation refers to novel ideas that upon implementation have produced more financial value than was invested into creating them (Stevens and Burley, 1997) – i.e. financially and commercially successful innovations. Taatila et al. continue by arguing that from a business point of view these innovations are primarily interesting due to their positive financial effects, as they either increase cash flow (for instance as a new product or a new successful strategy, or as a capability to penetrate new markets [Dougherty, 1996]) or decrease costs (for example as a more efficient production process). Thus, an economic innovation is something genuinely new that brings added value to a company (Haho, 2002; Stahle et al., 2004; Urabe, 1988). In addition to the financial point of view, a series of other innovation definitions and classifications have been presented (e.g. Kirner 2006; Moldaschl 2006; Rogers 2003; Drejer 2004; Coombs and Miles 2000; Leiponen and Drejer 2005, 2007; Hauknes, 2003). Practical need, intellectual curiosity, surprise and serendipity can result in the birth of a new invention (Dasgupta, 1996; Thagard, 1999).

**Practical need** is often the starting point for an invention. The need can be social (everybody understands it) or individual. For example, many inventions in information and communication technology (ICT) are created when an ICT expert finds an IT application to be very irritating. In a business context, business interests create the need to innovate. Sometimes it is a simple compulsion to create something new for business operations to proceed with. The old adage of necessity being the mother of invention (Dasgupta 1996, p. 20) describes this aspect.

**Intellectual curiosity** can initiate idea generation that leads to a new discovery. Curiosity has been regarded as a starting point for science and in art. Intellectual curiosity can be an important basis for the innovation process because the process is often uncertain and personal motivation and long-term emotional commitment are required. Often the goal of innovation is not direct profit, but a human's basic need to know more about the world and its phenomena. The FogScreen innovation is a good example of intellectual curiosity as the starting point for innovation. Senior researcher Ismo Rakkolainen at the University of Tampere, Finland, began thinking in summer 2000 about the possibility of reflecting pictures and movies off a fog screen. He went to discuss the idea with his friend, Professor Karri Palovuori, and their discussion led to a clearer idea of the fog screen. The idea was based on intellectual curiosity, and the basic goal was not to found a company. However, it led the inventors to establish FogScreen, Inc. Tuomi (2002) relates the history of the Linux innovation. The idea arrived when the hacker community was interested in developing better open source code. Originally, the question was not commercial profitability, although Linux does have a commercial role nowadays. In the long term, many scientific and technological discoveries are commercially significant, although their starting points were in intellectual curiosity.

**Surprise** may also be behind the idea generation process. An individual may recognise things that are incompatible with his/her previous knowledge or beliefs. A surprise perception starts the cognitive process, in which the person tries to explain the novelty, unexpected finding or other peculiarity. The surprise perception often sets off an abductive reasoning process for finding the explanation. When we notice something puzzling about a phenomenon we try to understand it. Surprise is a very subjective experience and it is typical of creative individuals that they can interpret what for others is an ordinary situation as a surprise (Suomala et al., 2006).

**Serendipity** (lucky insight) may start a creation process or lead to a direct invention. Serendipity is the process by which we accidentally discover something fortunate, especially while looking for something else entirely (Thagard and Croft, 1999). George de Maestral invented the hook-loop fastener (Velcro brand) after observing how tenaciously cockleburs stuck to his wool pants. He had no intention of inventing this kind of material, but he discovered it accidentally through perception.

Practical need, intellectual curiosity, surprise and serendipity are not opposite; the creative process can start with the combination of all these. Many individuals make practical innovations through intellectual curiosity. Masaru Ibuka, one of the founders of Sony Corporation and the inventor of many Sony products has said that he creates because novelties produce great pleasure and because invention fulfils his curiosity (cf. Dasgupta, 1996, p. 26).

### *2.2 Summary*

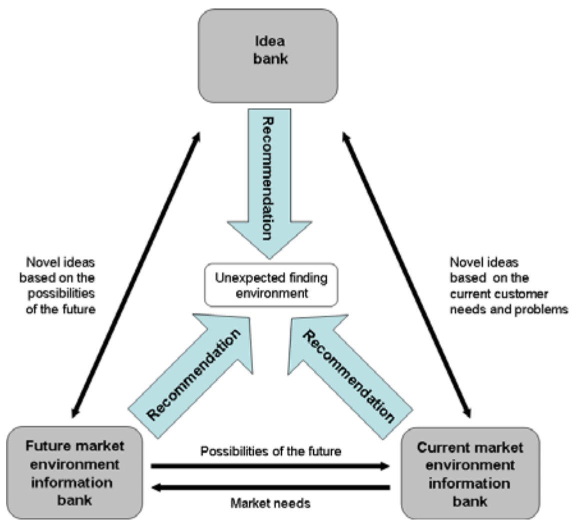
Although novel ideas are often born in individuals' minds, new ideas cannot appear without social practices and norms of for instance the work/study environment, funding, R&D policy, universities, research institutes and laboratories, libraries and journals, reward systems, authority, methodology and ethics. Thus the creative process is the coevolution of an individual mind and a cultural environment. When an individual learns (adaptively or creatively) he/she uses outer and inner resources for learning (Shirouzu, Miyake and Masukawa, 2002). Inner resources are the individual's memory and intentions, while outer resources are social and material resources. The use of knowledge and social resources for the innovation process is motivated and organised by and gets meaning from the social environment. Thus the source of new ideas and innovations is a coevolution process between an individual and a social environment, such as an online social network.

## 3 Defining the National Open Innovation System (NOIS)

### *3.1 Introducing the Innovation Triangle*

Figure 1 presents the general Innovation Triangle framework which consolidates our National Open Innovation System (NOIS).

**Figure 1** The Innovation Triangle




Our framework includes two complementary innovation sources: first, future market environment information (i.e. the box on the left in the figure) and second, current market environment information (i.e. the box on the right). Most interestingly, to create an environment for unexpected findings, we have integrated a content recommendation tool into our idea and the information bank framework. These individual functional components and the interface between them form a part of the overall functionality, which we named the National Open Innovation System (NOIS). Below is a more detailed description of our framework.

### *3.2 Innovation source 1: future market environment data bank*

The left-hand box in Figure 1 represents the future market data bank. The theoretical basis of this bank derives from futures research and foresight theories. The European Union's foresight best practice project FOR-LEARN gives the following definition for foresight: *"Foresight is a systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilizing joint actions. Research and innovation policies are based on (implicit or explicit) visions of the future of science, technology and society."* This is interesting, because it combines foresight research with innovation policies such as NISs.

In foresight people typically follow: (1) trends and anti-trends, (2) expected future scenarios (either explorative forecasting or normative back-casting scenarios) or (3) emerging weak signals and seeds of change. Often analytical foresight analysis starts by analysing existing dependencies. This part of the study can be called (1) hindsight (focused on historical trends) pr (2) insight analyses (focused on current problematic situation). Typical parts of foresight exercises are: (1) designing an exercise, (2) running the exercise and (3) evaluative follow-up of the exercise. Strategically there are two basic alternatives for foresight research in relation to an innovation: (1) before the actual innovation is identified and (2) after the innovation is identified. Typically the innovation process is seen as linear, with three phases: (1) R&D phase, (2) production phase and (3) marketing phase. Innovations are typically expected to happen in the linear form of the conventional R&D phase (Takeuchi and Nonaka, 1986; FOR-LEARN 2007; Salmenkaita and Salo, 2002).

According to Kaivo-oja (2006), we can connect foresight systems and innovation systems in the following seven alternative ways, which are non-linear rather than the conventional linear (Takeuchi and Nonaka, 1986, see details in Appendix 1). We present seven theoretical alternative interaction models, which all are possible in modern firms and corporations. We consider that foresight systems can play and actually often do play an important part in relation to innovation systems.

Foresight activities are often performed by knowledge-intensive business companies and these kinds of companies are also coproducers of innovations. Theoretically these kinds of complex interactions can explain the new empirical findings of Leiponen and Drejer (2005). We can expect that the five technological or innovative regimes – (1) the supplier-dominated regime, (2) the production-intensive regime, (3) the scale or science-based regime, (4) the market-driven regime and (5) the passive/weak innovation regime – are based on different kinds foresight system/innovation system interactions. Table 1 connects the technological and innovative regimes of Leiponen and Drejer (2005) to the foresight/innovation interaction models presented above (Kaivo-oja, 2006).

**Table 1** Technological/innovative regimes and likely interaction models between foresight systems and innovation processes (source: Kaivo-oja, 2006)

| *Technological/innovative regime* | *Most likely interaction models* |
|---|---|
| Supplier-dominated regime | IFO (innovation concerning supply chains or sub-contractor relations lead to foresight process), IOF (innovation concerning supply chains or sub-contractor relations lead changes in production), OFI (changes in supply chains or sub-contractor relations lead to foresight process), OIF (changes in supply chains or sub-contractor relations lead to innovation process), ISP (general model) |
| Production-intensive regime | OFI or OIF (changes in production and marketing lead to foresight analysis or novel innovation process), ISP (general model) |
| Scale or science-based regime | FIO (science-based foresight leads to innovation), FOI (science-based foresight leads to production changes), IFO (science produces innovation and needs for foresight analysis), IOF (science produces innovation and fast changes in production), ISP (general model) |
| Market-driven regime | OFI (production or market change leads to foresight and innovation), OIF (production or market change leads to innovation and innovation-related foresight), FIO (foresight concerning production and market development leads to innovation and related changes in production and marketing), FOI (foresight concerning production and market development leads to changes in production and this change creates innovation), ISP (general model) |
| Passive/weak innovation regime | No remarkable interaction, ISP (general model) |

### *3.3 Innovation source 2: current market environment data bank*

The right-hand box in Figure 1 represents the current market data bank. The theoretical basis of this bank derives from customer and market orientation strategy literature. A customer orientation strategy, which is commonly linked to market orientation strategy (Kohli and Jaworski, 1990), can be defined as a strong desire to identify customer needs and the ability to answer recognised needs. Others authors have presented similar definitions (e.g. Narver and Slater 1990; Deshpande et al. 1993; Gatignon et al. 1997). The theory is grounded in the basic belief that companies that satisfy their customers' individual wants and needs better will eventually have higher sales (Pine, 1993).

In order to fully understand customer behaviour, companies should systematically collect and analyse a significant amount of data on their customers' behaviour and their competitors' actions. With such in-depth analyses, companies can apply e.g. customer segmentation strategies or so-called cradle-to-grave strategies, which emphasise the lifetime value of a customer (Pitta et al. 2006; Zeithaml et al. 2001). From an organisation's point of view, extensive idea-generation based on customer data might be problematic, as this process is typically very resource-intensive. Even though the Internet has significantly helped companies collect customer feedback (on e.g. problems or needs), more in-depth interviews or large-scale focus groups with customers are still often avoided due to high expenses. As the data collection process in general has become easier, companies now produce more customer behaviour data, which can be used as a foundation for idea-generation. However, a large proportion of these huge amounts of available data is often unused due to understaffing problems. Interestingly, this resource shortage might be overcome with the help of an extensive human resource network such as NOIS. A good practice is to build consumer scenarios to identify key issues of consumer behaviour and consumer needs (cf. Alexander and Maiden, 2004). It is also possible to use Customer Experience Management (CEM) and Customer Relationship Management (CRM) tools (cf. e.g. Meyer and Schwager, 2007). In order to understand the current market environment the NOIS framework classifies the current market environment according to the following categories: 1) customer needs, 2) customer problems, 3) occurrence and 4) competitor action.

## 4. Increasing the Likelihood of Unexpected Findings With the Help of Content Recommendation

### *4.1 Theoretical foundations of recommendation*

When the amount of content increases in a website such as our NOIS, we must provide intelligent services to end-users in order to create a solid user experience. Site-specific search functions have typically been the fastest and easiest way to help users find what they want. However, this approach mainly supports expected finding events as a typical source of novel innovation (i.e. the user needs to find something specific and can complete the task with the help of the search function). In addition to user-driven search functions and an intuitive site structure, the most advanced sites, such as Amazon.com and Youtube.com, automatically recommend content to users. These features can increase the likelihood of unexpected findings and increase sales (for example in the case of Amazon).

Content recommendation on a mass production scale is a kind of mass customisation management system, which go back more than thirty years (Toffler, 1970; Davis, 1987; Pine, 1993). In the online environment, the term personalisation often replaces customisation or more specifically mass customisation, although the definitions of these terms are not very alike in our opinion. Personalisation generally refers to making a site more responsive to the unique and individual needs of each user (e.g. Cingil et al., 2000) while in a mass customisation management system the goal is to develop, produce, market, and deliver affordable goods and services with enough variety and customisation that nearly everyone will find exactly what they want (Pine, 1993). In practice, mass customisation means that customers can select, order and receive a specially configured product – often choosing from among hundreds of product options – to meet their specific needs (Bourke and Kempfer, 1999).

Most importantly, in many cases heterogeneous customer needs mean that a true desire and willingness to listen to customer needs (i.e. customer orientation) should lead to mass-customised products and services (Santonen, 2007). In principle at the extreme level of customisation, a company can produce and market unique products for all customers. Pepper and Rodgers (1996) defined this extreme customer orientation strategy approach as one-to-one marketing, while making a difference between individual customers and customer segments, which are more commonly related to mass customisation management systems. The authors behind the ideas of mass customisation and one-to-one marketing (Pine et al., 1995) later joined forces and argued that a company hoping to deliver customers exactly what they want (i.e. implement the extreme customer orientation strategy) must utilise both mass customisation and one-to-one marketing management systems.

### *4.2 Implementing the content recommendation in NOIS*

Below we will describe our implementation strategy for content recommendation, which is a typical way for websites to provide a customised user experience. According to Santonen (2003), websites' content recommendation can be based on user preferences, content or user similarity (i.e. collaboration). Manual decision rule-based systems allow site administrators to specify rules based on end-user preferences, demographics or static profiles, which are collected through a registration process or session history (Mobasher et al., 2000). In a pure content-based recommendation system recommendations are made on the basis of a profile generated by analysing content, while a pure collaborative recommendation system does not analyse content at all but recommends items that similar end-users have liked or used (Balabanovic and Shoham, 1997). In practice, the following recommendation approaches have been identified (Santonen, 2007): recommendation based on (1) usage or click-thorough history, (2) pre- or user-defined keywords (Mobasher et al., 2000), (3) simultaneous versions (Lampel and Minzberg, 1996), (4) purchase history (e.g. www.amazon.com), and (5) user-performed rating (Balabanovic and Shoham, 1997).

In our NOIS concept, content recommendation for users will be based on a combination of the presented recommendation alternatives. These recommendation features will help us increase the likelihood of unexpected findings e.g. by combining and linking different ideas and idea sources in novel ways that the users themselves cannot manually or intuitively create. The automatic novel combinations can trigger surprise, serendipity or curiosity reactions in users' brains, which leads to innovation.

## 5. Conclusion

In this study we have presented a new approach based on people-to-people interaction, which we named the National Open Innovation System (NOIS). To increase the likelihood of unexpected user findings and to support the creation of novel ideas, a content recommendation tool was integrated into our NOIS. From a theoretical point of view, the presented NOIS is an open innovation model for emerging online social networks (OSNs), which have achieved unprecedented popularity in recent years. With our concept we have pointed out that OSNs can also play an important technological and social role in the commercialisation process of novel ideas and inventions. OSNs can support commercialisation of new ideas, inventions and innovations on a large scale, especially if the graphical user interface supports unexpected findings. Due to the nature of our study (aimed to define a concept), the validity of our arguments calls for future research. In order to prove our points regarding utility, we should empirically verify our value promises.

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**Appendix 1.** The models of interaction between the foresight system and the innovation process

**Figure 1** Model I: Innovation-Foresight-Other processes (IFO) model

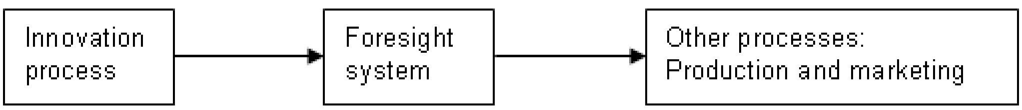


**Figure 2** Model II: Foresight-Innovation-Other Processes (FIO) model

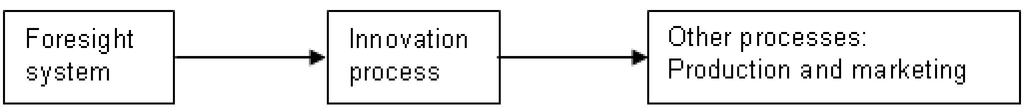

**Figure 3** Model III: Other industrial processes-Foresight-Innovation (OFI) model

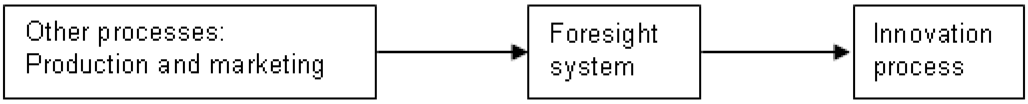


**Figure 4** Model IV: Other industrial processes-Innovation-Foresight (OIF)

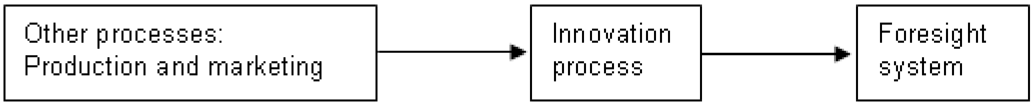


**Figure 5** Model V: Foresight-Other industrial processes-Innovation (FOI)

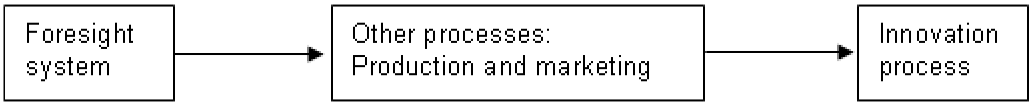


**Figure 6** Model VI: Innovation-Other industrial processes-Foresight (IOF)

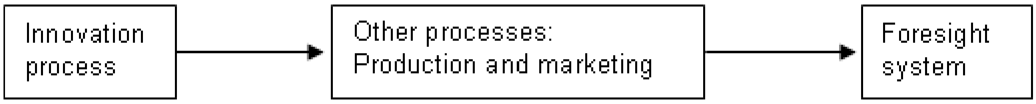


**Figure 7** Model VII: Interactive simulative process model (ISP)